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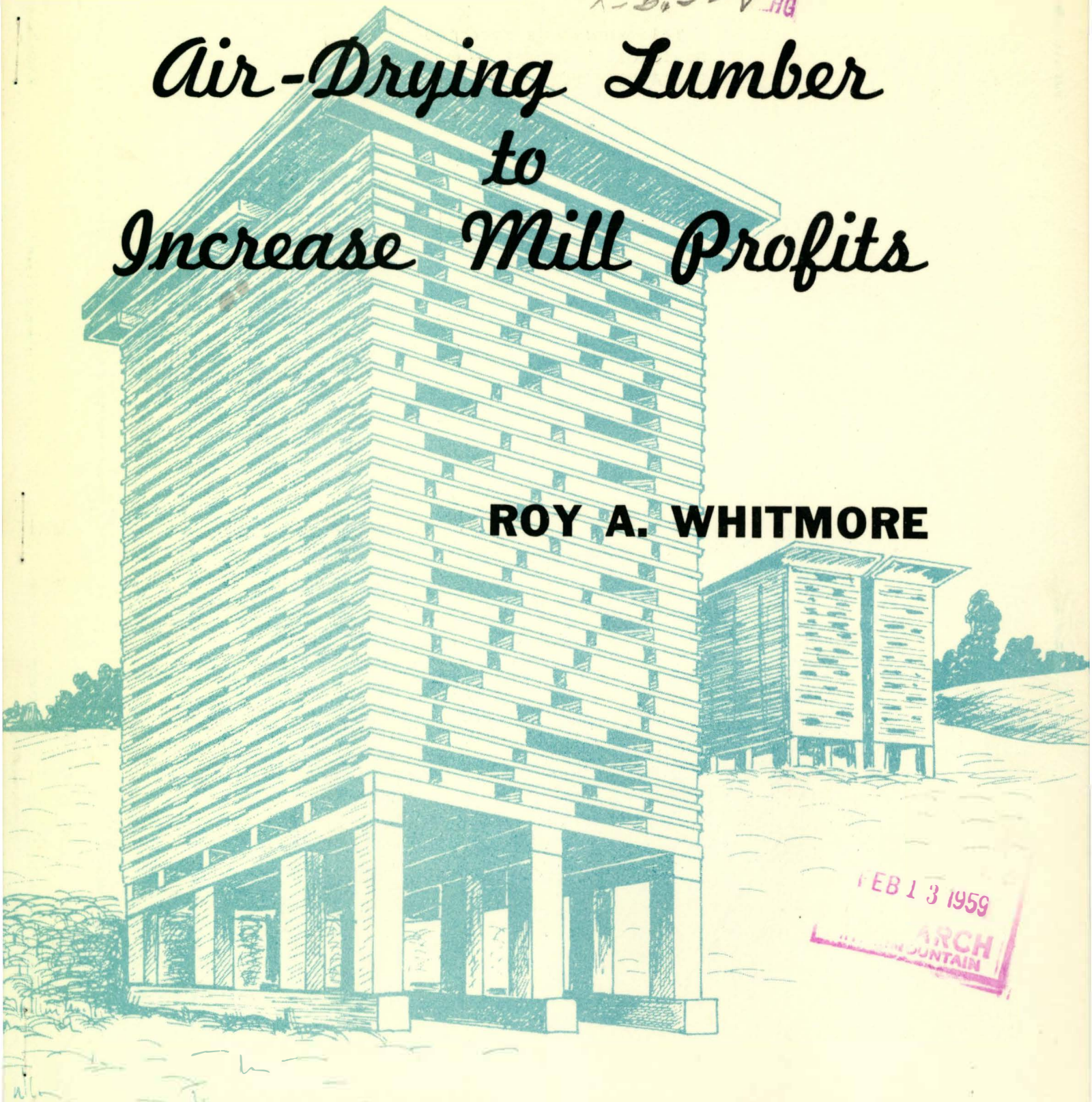
Air-Drying Lumber to Increase Mill Profits



ROY A. WHITMORE

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RESEARCH
INTERMOUNTAIN

U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
CENTRAL STATES FOREST EXPERIMENT STATION - W. G. McGINNIES, DIRECTOR

This report is from the
Division of Forest Economics
CENTRAL STATES FOREST EXPERIMENT STATION

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SUMMARY

This study was made to find out how much a sawmill operator could increase his profits by marketing air-dried, factory-grade hardwood lumber rather than green lumber. It was found that:

1. Selling lumber air-dried rather than green resulted in an increased profit averaging $11.65 per thousand board-feet.

2. Board-foot loss due to shrinkage was almost 3 percent of the green lumber tally.

3. Sap stain, the most serious cause of degrade during seasoning, amounted to 1.71 percent of the air-dried volume.

4. End split and checking caused degrade in only 1 percent of the air-dried lumber. It was most prevalent in 8/4 lumber 10 inches and wider.

THE AUTHOR

ROY A. WHITMORE, JR. joined the staff of the Central States Station in January of 1952 and was assigned to the Forest Survey in Ohio, Indiana, and Iowa. In September 1954 he was transferred to the Carbondale Forest Research Center and served as project leader in forest products marketing. Two years later he returned to Ohio to open the New Philadelphia Field Office. In February of 1958 he was transferred to Washington, D. C. serving in the Division of Forest Economics Research until he resigned in July 1958 to accept his present position as Associate Professor of Forestry at the University of Vermont. Whitmore attended the University of Vermont and received a bachelor's and a master's degree in forestry from the University of Michigan. He has studied at Southern Illinois University and the USDA Graduate School. Whitmore has authored or co-authored eight publications in the fields of mensuration, utilization, and marketing.

Air-Drying Lumber to Increase Mill Profits

INTRODUCTION

Very little of the lumber manufactured in small- and medium-sized mills in the Central States is dried prior to sale. Drying is usually left to the concentrator or final processor. However, with rising costs of stumpage and manufacture, sawmill operators are caught in a squeeze between increasing production costs and constant or decreasing selling prices. One promising way for a small mill operator to increase his profits is through the proper manufacture and sale of air-dried, factory-grade lumber.

Many small sawmill operators, however, shy away from drying because they are afraid it would be too costly in terms of possible degrade and elaborate equipment needed and because it delays sale of the lumber. Moreover, they don't feel that they produce enough lumber to make it worthwhile. It was to find out just how much of this reluctance is justifiable that the study reported here was made.

PROCEDURE

This case study was made at a small sawmill in eastern Ohio. More than 13,000 board-feet of fresh-sawed oak lumber was measured and graded. The lumber was air seasoned using the best procedures that were considered applicable to small sawmill operation. This included constructing pile foundations, piling the lumber carefully and systematically with the proper use of stickers, and using covers on piles.

After 120 days of drying the lumber was sold. Grades and value were compared with value for the same lumber if it had been sold to the same markets in the rough-green condition. Price comparisons were made on local quotations as of May 1957 when the lumber was piled and 120 days later when it was taken down. There were no major price changes either for rough-green or air-dried lumber during the seasoning period.

SPECIES, GRADES, AND THICKNESSES

Lumber selected for the study was of two species (white and red oak), two thicknesses (8/4 and 4/4), and two grades (FAS and #1C)[1/]. These grades if properly seasoned will return the greatest profits, but if poorly seasoned will result in the greatest loss. Lower grades were not used because air-drying usually does not increase sale value of these grades enough to warrant the expense of air-drying.

FOUNDATIONS

Pile foundations similar in design to those recommended by the Forest Products Laboratory[2/] were built from 6 x 6 treated timber (fig. 1). The foundations were 9 feet wide and 16 feet long and sloped 1 inch per foot of length from front to rear. The rear height of the foundations was 18 inches. Crossbeams of 4 x 4's were placed across the stringers at 2-foot intervals. These were not treated but were painted with an antistain solution of sodium pentachlorophenate. The surface dimensions of each foundation were 9 x 16 feet.

1/ Grades established by NHLA rules book.

2/ Peck, Edward C. Air drying of lumber. Forest Prod. Lab. Rpt. 1657 (Rev.), 21 pp. plus illus. 1956.

Figure 1.--Box-piled lumber with chimney between piles.

PILING

Adjustments in piling can insure the proper air circulation for the drying of a particular species and thickness. Horizontal circulation of air caused by wind currents can be regulated to some extent by yard layout and spacing of piles. Vertical circulation can be regulated to some extent by altering the spaces between boards in the pile.

All of the lumber was box piled. Two box piles 4 feet wide were made on each foundation with a 1-foot chimney between the piles (fig. 1). Narrow piles of this type tend to increase the drying rate.

The longest boards or planks were placed in the outer tiers of each pile. Short boards were placed alternately flush with the front and rear ends of the pile. Where enough long boards could not be found for the outer tiers, blocks were inserted between the stickers to prevent sagging. The piles were stacked by hand and ranged from 8 to 12 feet in height.

Stickers

The function of stickers is to provide support for the pile, separate courses of lumber, and to restrain warping by holding the lumber flat. The number and positioning of stickers has an important effect on the occurrence of seasoning defects. Thin lumber needs more stickers than thick lumber to reduce warping. High-grade lumber and species prone to warp should be piled with more stickers.

When seasoning the better grades of lumber, the use of special stickers is justified. Special stickers--seasoned, cut to uniform size, surfaced, and treated--will reduce checking, stain, and warp.

Stickers 1 1/4 inches wide were cut from 4/4 oak lumber. They were surfaced two sides to 7/8 inches thick and trimmed to 54 inches (slightly wider than the piles). All of the stickers were treated in sodium pentachlorophenate and seasoned before using.

The lumber was piled with stickers 2 feet apart. The stickers were aligned with the crossbeams of the foundation. None of the lumber was end trimmed, therefore stickers could not be placed perfectly flush or overhanging the ends of the piles (fig. 2).

Pile Covers

A good pile cover is an essential part of good air-drying. A cover protects the top courses from rain and direct sunshine. When a cover is not used the top courses are subject to warping and checking and rain penetrates the pile retarding drying and increasing the chances of stain. A panel-type cover consisting of a frame and a water-tight surface should be used on piles of #1 Common and Better lumber.

Panel-type pile covers 5 x 10 feet in size were constructed using a frame of 2 x 4's sheathed with 4/4 lumber. This was covered with 55-pound roll roofing and all joints were cemented. Two small covers were used instead of one large one on each pile in order to facilitate handling. They were placed with the front panel overlapping the rear one (fig. 1). Overhang was 1 foot at the front and 2 feet at the rear. Covers were supported on the top course of lumber by 4 x 4's the width of the covers. Only the front covers were tied down; the overlap helped to hold the rear covers in place.

Figure 2.--Box-piling 8/4 red oak lumber with stickers flush with front of pile.

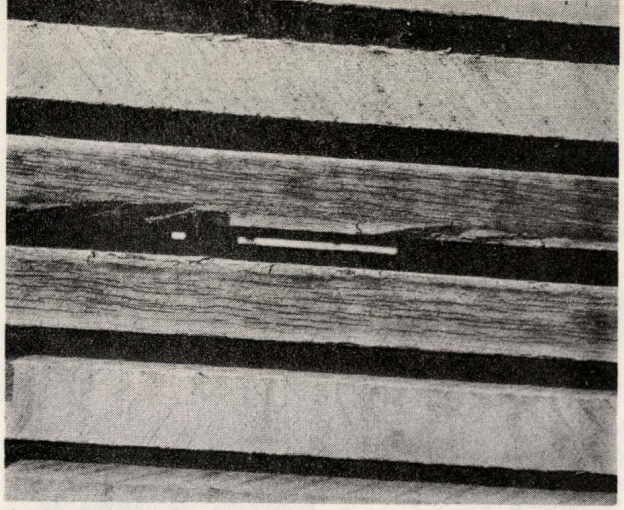

Figure 3.--Edge view of sap-stained white oak lumber on outside of pile.

Figure 4.--Sap stain in oak lumber stopped where the treated stickers crossed the board.

COMPARING THE RESULTS

Effect of Air-Drying on Volume and Grade

When piled there were 1,212 pieces of lumber totaling 13,479 board-feet distributed among the species, grades, and thicknesses (table 1). At the time of the final inspection, this same lumber tallied 13,090 board-feet. Changes in volume of lumber by grade were the result of losses incurred during the air-seasoning process and came from three sources: Stain, shrinkage, and splits and end checking.

Stain.--In this study, the majority of the stained boards contained high percentages of sapwood and were located on the sides of the piles (fig. 3). These boards, though located in an area of rapid drying, were subjected to repeated wettings by rain which kept their moisture content above 20 percent for some time.

Stain caused the degrade of 22 pieces amounting to 1.71 percent of the air-dried volume. Slightly more than half of the loss due to stain occurred in 8/4 lumber. No losses due to sticker stain were found. Where stain did occur on a board, it stopped where a sticker crossed the board (fig. 4).

Table 1.--Change in grade, volume, and value when green lumber was air-dried

Grade	Pieces		Volume		Price per thousand board-feet		Gross value	
	Green	Air-dry	Green	Air-dry	Green	Air-dry	Green	Air-dry
	Number	Number	M Board-feet	M Board-feet	Dollars	Dollars	Dollars	Dollars
8/4 WHITE OAK								
FAS	139	131	2,247	2,042	200	225	449.40	459.45
1C	152	160	2,165	2,252	105	125	227.32	281.50
Total	291	291	4,412	4,294	305	350	676.72	740.95
8/4 RED OAK								
FAS	112	107	1,938	1,801	180	205	348.84	369.20
1C	123	126	1,885	1,872	105	125	197.92	234.00
2C	--	2	--	30	--	90	--	2.70
Total	235	235	3,823	3,703	285	420	546.76	605.90
4/4 WHITE OAK								
FAS	169	162	1,241	1,168	160	205	198.56	239.44
1C	214	217	1,533	1,505	85	125	130.30	188.12
2C	--	4	--	28	--	90	--	2.52
Total	383	383	2,774	2,701	245	420	328.86	430.08
4/4 RED OAK								
FAS	98	93	834	780	150	170	125.10	132.60
1C	205	206	1,636	1,578	85	105	139.06	165.69
2C	--	4	--	34	--	90	--	3.06
Total	303	303	2,470	2,392	235	365	264.16	301.35

Shrinkage.--The moisture content of the lumber at the end of the drying period averaged about 14 percent for the 4/4 and 16 percent for the 8/4 lumber. Board-foot shrinkage amounted to 2.89 percent of the original board measure. This shrinkage was in width because all of the boards still met minimum thickness standards. When piled, many of the 6-inch boards just made the minimum width specifications. After the drying period, some of them no longer met the minimum width specifications (fig. 5). Degrade due to shrinkage amounted to 0.24 percent of the air-dried volume.

Splits and end checking.--Splits and end checks that occur within or adjacent to the wood rays are the result of tensile stresses that develop on the flat- and end-grain faces. The flat and end surfaces dry and shrink while the center of the board is still wet. The ends of the boards are usually more completely exposed to the atmosphere than are the flat-grain surfaces, and the position of the wood cells or fibers with respect to the end-grain surfaces makes them particularly susceptible to checking. End checks are likely to develop into splits, especially where the ends are exposed to drying under direct sunshine and to wetting by precipitation.

Loss due to end splits and checks caused the degrade of 7 pieces amounting to 0.99 percent of the air-dried, board-foot volume. All but one of the pieces having end splits were 8/4 lumber (fig. 6). Most of the losses in the 8/4 occurred in boards 10 inches and wider. Degrade due to splits was greatest in the FAS grade.

Effect of Air-Drying on Lumber Value and Profit

Markets for air-seasoned lumber are fairly well distributed throughout the Central States, particularly near the large centers of population and manufacture. Often air-seasoned lumber can be sold at a premium price. The lumber produced in this study was more valuable than it would have been green. The price the operator was setting for 8/4, FAS, rough-green red oak during the period of this study was $180 per thousand board-feet. The same grade, thickness, and species air-dried sold for $205 per thousand board-feet--$25 per thousand more. If the lumber used in this study had been sold in rough-green condition, it would have been worth $1,816.50. Dried, it sold for $2,078.28, an increase of $261.78 (table 1).

Air-seasoning costs include materials and construction of the foundations, covers, and stickers, also the cost of equipment and labor used in piling the lumber. The costs of the foundations,

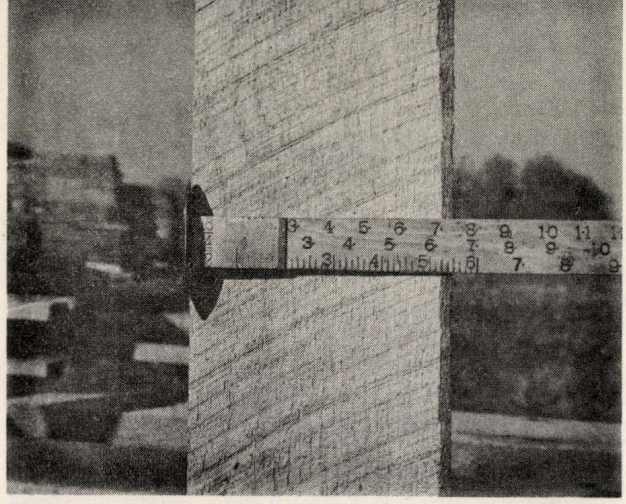

Figure 5.--This board when green was wide enough for the 6-inch class; when air-dried, shrinkage dropped it to the 5-inch width.

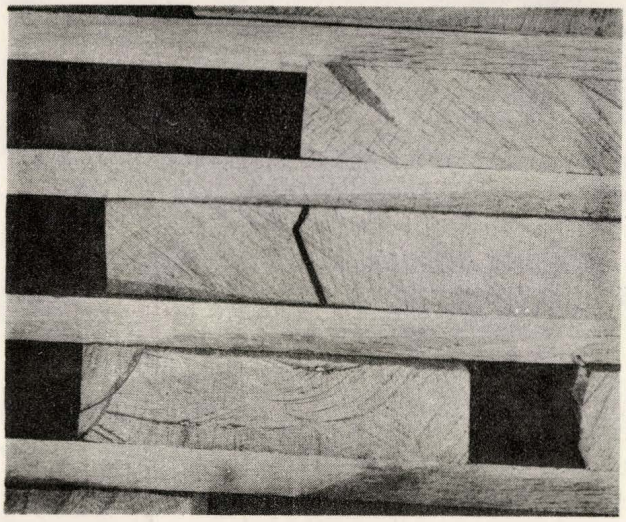

Figure 6.--End split and small checks in 8/4 white oak lumber.

covers, and stickers were amortized over a period of years. Air seasoning cost $7.59 per thousand board-feet for 8/4 and $9.53 per thousand board-feet for 4/4 lumber (table 2). The increased profit realized averaged $11.65 per thousand board-feet including shrinkage and degrade (table 3).

Table 2.--Piling cost summary per thousand board-feet

(Labor and materials amortized)

Item	8/4	4/4
	Dollars	Dollars
Foundations	0.79	0.79
Pile covers	.86	.86
Stickers	.76	1.37
Piling	4.36	5.69
Yard	.82	.82
Total	7.59	9.53

Table 3.--Cost and return summary for air-drying

Lumber thickness	Volume	Increased returns	Increased costs	Net increased return Total	Net increased return Per M bd.-ft.
	Board-feet	Dollars	Dollars	Dollars	Dollars
8/4	7,997	123.37	60.70	62.67	7.84
4/4	5,093	138.41	48.54	89.87	17.65
Total	13,090	261.78	109.24	152.54	11.65

DISCUSSION AND CONCLUSIONS

The results of this study indicate that a sawmill operator can significantly increase the total value of the lumber he manufactures and the profit he makes from it--by careful air seasoning.

The uncertainty of future markets and prices may discourage air-drying of lumber if money has to be borrowed to cover expenses during the seasoning period. The net profit obtained here represents a return of 8 percent of the investment in inventory and piling costs.

Two basic requirements for high returns from air seasoning lumber are: (1) Check your market to be certain of price differentials offered between green and air-dried lumber, and (2) use the best seasoning practices at a minimum of cost.

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